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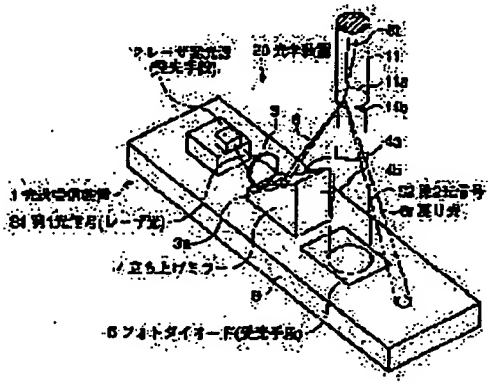
(54) OPTICAL TRANSMITTER/RECEIVER AND OPTICAL TRANSMITTING/ RECEIVING METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an optical transmitter/receiver and an optical transmission/ reception m thod capable of preventing the generation of crosstalk at the time of executing optical transmission/reception and improving th efficiency of optical transmission/reception.
SOLUTION: The optical transmitter/receiver is provided with a light emitting means 2 for emitting a 1st optical signal S1, an optical device 20 for making the 1st optical signal S1 emitted from the means 2 incident upon the incident end of an optical fiber 11 along a direction different from the exiting direction of a 2nd optical signal S2 from the end part 11a of the fiber 11 and a light receiving means 5 for receiving the 2nd optical signal S2 exiting from the end part 11a of the fiber 11. When the 1st optical signal S1 is made incident upon the end part 11a of the fiber 11, the means 5 is arranged on the outside of an arriving area of reflected light generated by reflecting the signal S1 on the end part 11a of the fiber 11.



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CLAIMS

[Claim(s)]
[Claim 1] While making the edge of said optical fiber carry out incidence of the 1st lightwave signal which it connects with the optical fiber used for a 1 heart bidirectional optical-communication circuit, and is going to transmit The luminescence means which is an optical transmitter-receiver for receiving the 2nd lightwave signal sent through said optical fiber, and carries out outgoing radiation of said 1st lightwave signal, A light-receiving means to receive said 2nd lightwave signal which carries out outgoing radiation from said edge of said optical fiber, The optical equipment to which said 2nd lightwave signal meets in the different direction from the direction which carries out outgoing radiation from said edge of said optical fiber, and the incidence edge of said optical fiber is made to carry out incidence of said 1st lightwave signal of said luminescence means, The optical transmitter-receiver characterized by arranging said light-receiving means outside the field at which the reflected light produced because said 1st lightwave signal reflects at said edge of said optical fiber arrives when it **** and the edge of an optical fiber is made to carry out incidence of said 1st lightwave signal.
[Claim 2] For the direction where said 2nd lightwave signal carries out outgoing radiation of the condensing member which condenses said 1st lightwave signal of said luminescence means, and the optical path of said 1st lightwave signal which condensed from the edge of said optical fiber, said optical equipment is an optical transmitter-receiver according to claim 1 which has the directional change component to which change in the different direction and the edge of an optical fiber is made to carry out incidence.
[Claim 3] For the direction where said 2nd lightwave signal carries out outgoing radiation of the optical path of said 1st lightwave signal from the edge of said optical fiber, the directional change component of said optical equipment is an optical transmitter-receiver according to claim 2 which has the reflective film in the reflector for changing in the different direction.
[Claim 4] Said reflective film is an optical transmitter-receiver according to claim 3 which is the total reflection film.
[Claim 5] The optical transmitter-receiver according to claim 1 which has the package which holds said luminescence means, said optical equipment, and said light-receiving means and by which said edge of said optical fiber is attached in said package removable towards said light-receiving means.
[Claim 6] The optical transmitter-receiver according to claim 5 by which the protection-from-light means for preventing the light of said luminescence means leaking from said package when said optical fiber has separated from said package is arranged at said package.
[Claim 7] An optical transmitter-receiver [equipped with the condensing component for condensing said 2nd lightwave signal and carrying out incidence to said light-receiving means] according to claim 1.
[Claim 8] While making the edge of said optical fiber carry out incidence of the 1st lightwave signal which it connects with the optical fiber used for a 1 heart bidirectional optical-communication circuit, and is going to transmit It is the optical transceiver approach for receiving the 2nd lightwave signal sent through said optical fiber. Said 2nd lightwave signal meets in the different direction from the direction which carries out outgoing radiation from said edge of said optical fiber. The optical transceiver approach characterized by not receiving the reflected light in said edge of said optical fiber of said 1st lightwave signal while receiving said 2nd lightwave signal in which is made to carry out incidence of said 1st lightwave signal of a luminescence means to said edge of said optical fiber, and a light-receiving means carries out outgoing radiation from said edge of said optical fiber.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the optical transmitter-receiver and the optical transceiver approach for 1 heart bidirectional optical communication.
[0002]
[Description of the Prior Art] The method which transmits a signal by optical communication greets diversification of an information communication link, and its need is increasing increasingly. When transmitting a signal by optical communication, the two-way communication circuit method of 1 heart method which usually used one optical fiber, and the two-way communication circuit method of 2 heart methods using two optical fibers are used. The optical transmitter-receiver as shown in drawing 18 is used for the 1 heart bidirectional optical communication type. The conventional optical transmitter-receiver shown in drawing 18 needs to divide the optical path of optical transmission and optical reception, in order to realize 1 heart bidirectional optical communication. The optical path for transmission is an optical path which the light which carried out outgoing radiation from the source 1002 of laser luminescence is bent by reflector 1004a of a beam splitter 1004, passes along the joint lens 1003, and carries out incidence to edge 1011a of an optical fiber 1011.
[0003] The optical path for reception is an optical path which it is condensed with the joint lens 1003, and the outgoing radiation light from an optical fiber 1011 penetrates reflector 1004a of a beam splitter 1004, and carries out incidence to a photodiode 1005. That is, in order to divide the optical path the object for transmission, and for reception, the beam splitter 1004 is used.
[0004]
[Problem(s) to be Solved by the Invention] Thus, at the time of transmission, the light from the source 1002 of laser luminescence is reflected by reflector 1004a of a beam splitter 1004. However, when this light is reflected, what percent, that light penetrates reflector 1004a and enters as direct stray light 1008a into a beam splitter 1004. Thus, incidence of the stray light 1008a which entered into the beam splitter 1004 will be carried out also to a photodiode 1005. That is, a photodiode 1005 not only receives the light for reception by which outgoing radiation is carried out from the usual optical fiber 1011, but stray light 1008a as a cross talk will receive it. If this stray light 1008a carries out incidence to a photodiode 1005, S/N (a signal/noise) of a photodiode 1005 will deteriorate, and the transmission distance by the optical fiber 1011 will become short.
[0005] Although there is also an example which replaces with and uses for a beam splitter 1004 the polarization beam splitter doubled with oscillation polarization of the source 1002 of laser luminescence in another conventional example, since a laser beam is not the perfect linearly polarized light, generating of stray light 1008a at the time of transmission cannot be completely abolished in this case. moreover -- since it is reflected by reflector (mirror plane) 1004a of a beam splitter 1004 also when a photodiode 1005 receives the outgoing radiation light from an optical fiber 1011 -- the light for the reception -- what percent, that part did not reach a photodiode 1005 but is made useless. The receiving light reflected by reflector 1004a of a beam splitter 1004 may carry out incidence to the source 1002 of laser luminescence, and may make unstable the oscillation property of the source 1002 of laser luminescence. Then, this invention cancels the above-mentioned technical problem, and prevents generating of the cross talk in the case of performing optical transmission and reception in a 1 heart bidirectional optical-communication circuit, and it aims at offering the optical transmitter-receiver and the optical transceiver approach of gathering optical transceiver effectiveness.
[0006]
[Means for Solving the Problem] If the above-mentioned purpose is in this invention, while making the edge of said optical fiber carry out incidence of the 1st lightwave signal which it connects with the optical fiber used for a 1 heart bidirectional optical-communication circuit, and is going to transmit The luminescence means which is an optical transmitter-receiver for receiving the 2nd lightwave signal sent through said optical fiber, and carries out outgoing radiation of said 1st lightwave signal, A light-receiving means to receive said 2nd lightwave signal which carries out outgoing radiation from said edge of said optical fiber, The optical equipment to which said 2nd lightwave signal meets in the different direction from the direction which carries out outgoing radiation from said edge of said optical fiber, and the incidence edge of said optical fiber is made to carry out incidence of said 1st lightwave signal of said luminescence means, It is attained by the optical transmitter-receiver characterized by arranging said light-receiving means outside the field at which the reflected light produced because said 1st lightwave signal reflects at said edge of said optical fiber arrives, when it **** and the edge of an optical fiber is made to carry out incidence of said 1st lightwave signal.

[0007] This invention is an optical transmitter-receiver which receives the 2nd lightwave signal sent through this optical fiber while making the edge of an optical fiber carry out incidence of the 1st lightwave signal which it connects with the optical fiber used for a 1 heart bidirectional optical-communication circuit, and is going to transmit. The luminescence means of this optical transmitter-receiver carries out outgoing radiation of the 1st lightwave signal. A light-receiving means receives the 2nd lightwave signal which carries out outgoing radiation from the edge of an optical fiber. The 2nd lightwave signal makes the incidence edge of an optical fiber, as for optical equipment, carry out incidence of the 1st lightwave signal of a luminescence means along a different direction from the direction which carries out outgoing radiation from the edge of an optical fiber. Thereby, since the 2nd lightwave signal makes the edge of an optical fiber carry out incidence of the 1st lightwave signal of a luminescence means along a different direction from the direction which carries out outgoing radiation from the edge of an optical fiber, the optical path of the 1st lightwave signal and the optical path of the 2nd lightwave signal can be made to become independent nearly completely with optical equipment. From this, since a part of 1st lightwave signal does not receive light for a light-receiving means with the 2nd lightwave signal, the optical cross talk (stray light) in a light-receiving means can be lost. In this invention, if the light-receiving means is arranged outside the field at which the reflected light produced because the 1st lightwave signal reflects at the edge of an optical fiber arrives when the edge of an optical fiber is made to carry out incidence of the 1st lightwave signal preferably, prevention of generating of a cross talk (stray light) can be ensured.
[0008] In this invention, preferably, by optical equipment being equipped with a condensing member and a directional change component, after a condensing member condenses the 1st lightwave signal of a luminescence means, a directional change component can change it in the different direction from the direction where the 2nd lightwave signal carries out outgoing radiation of the optical path of the 1st lightwave signal which condensed from the edge of an optical fiber, and can carry out incidence to the edge of an optical fiber. Thereby, the edge of an optical fiber can be made to carry out incidence of the 1st lightwave signal of a luminescence means efficiently. Though it is an easy configuration, it can make it carry out incidence of the 1st lightwave signal to the edge of an optical fiber efficiently certainly preferably, in this invention, if it is made for the directional change component of optical equipment to have the reflective film in a reflector for the 2nd lightwave signal to change the optical path of the 1st lightwave signal in the direction in which the directions which carry out outgoing radiation from the edge of an optical fiber differ.
[0009] And if this reflective film is total reflection film preferably, there is no loss of the quantity of light of the 1st lightwave signal, and the edge of an optical fiber can be made to carry out incidence in this invention. If the edge of an optical fiber is turned to a light-receiving means and it is made to be attached in this package removable, an optical fiber can be easily detached [it has the package which holds a luminescence means, optical equipment, and a light-receiving means, and] in this invention, and attached to an optical transmitter-receiver. In this invention, if the protection-from-light means is arranged in the package in order to prevent the light of a luminescence means leaking from a package preferably, even if it is the case where an optical fiber separates from a package, it can prevent the light of a luminescence means leaking from a package outside.
[0010] In this invention, if it has the condensing component in order to condense the 2nd lightwave signal preferably and to carry out incidence to a light-receiving means, the incidence effectiveness over the light-receiving means of the 2nd lightwave signal can be gathered.
[0011] If the above-mentioned purpose is in this invention, while making the edge of said optical fiber carry out incidence of the 1st lightwave signal which it connects with the optical fiber used for a 1 heart bidirectional optical-communication circuit, and is going to transmit It is the optical transceiver approach for receiving the 2nd lightwave signal sent through said optical fiber. Said 2nd lightwave signal meets in the different direction from the direction which carries out outgoing radiation from said edge of said optical fiber. While receiving said 2nd lightwave signal in which is made to carry out incidence of said 1st lightwave signal of a luminescence means to said edge of said optical fiber, and a light-receiving means carries out outgoing radiation from said edge of said optical fiber It is attained by the optical transceiver approach characterized by not receiving the reflected light in said edge of said optical fiber of said 1st lightwave signal.
[0012] Since the 2nd lightwave signal makes the edge of an optical fiber by this carry out incidence of the 1st lightwave signal of a luminescence means along a different direction from the direction which carries out outgoing radiation from the edge of an optical fiber, the optical path of the 1st lightwave signal and the optical path of the 2nd lightwave signal can be made to become independent nearly completely. Since the optical cross talk (stray light) in a light-receiving means can be lost since a part of 1st lightwave signal is not received by the light-receiving means with the 2nd lightwave signal, and the reflected light in the edge of the optical fiber of the 1st lightwave signal is not received, the optical stock in a light-receiving means can be protected from this still more certainly.
[0013]
[Embodiment of the Invention] Hereafter, the gestalt of suitable operation of this invention is explained to a detail based on an accompanying drawing. In addition, since the gestalt of the operation described below is the suitable example of this invention, desirable various limitation is attached technically, but especially the range of this invention is not restricted to these gestalten, as long as there is no publication of the purport which limits this invention in the following explanation.
[0014] The example which connected in the network the home which drawing 1 considers as the object which can apply the optical transmitter-receiver of this invention, for example, is called the so-called KONEKUTIDDO home (Connected Home) with the information provider in the world is shown. In the house 200, various electrical machinery and apparatus, information machines and equipment, etc. are arranged. Through the external contents provider 201 to the access network 202, a home server 203 can be provided with information, or a house 200 can send information now to the contents provider

201 side through the access network 202 from a home server 203. Moreover, the antenna 204 is formed in the house 200 and the information from the contents provider 201 can be received now through a satellite 205. The method using the ground wave as the method of informational offer is also employable.

[0015] In the house 200 of drawing 1 , the control system 210 and the multimedia system 220 of the device mentioned above are prepared. In the control system 210, the signal path for controlling the device used at ordinary homes, for example, electric light 210A, refrigerator 210B, microwave oven 210C, interior unit 210D of an air-conditioner, electric carpet 210E, gas hot-water supply machine 210F, and the device 210G grade for remote medical treatments is formed. On the other hand, the multimedia system 220 forms the signal path which controls device corresponding to multimedia age, for example, computer 220A, telephone 220B, audio equipment 220C, pocket mold information-machines-and-equipment 220D, and digital still camera 220E, printer facsimile 220F, digital camcorder 220G, game machine 220H, and DVD (digital-versatile-disc [or] digital videodisc: trademark) player 220I, and television receiver 220J grade. The various devices of these control systems 210 and multimedia systems 220 can perform on-off control of each device of a control system 210, supply of the information on various devices, etc., or can operate now switch-on and switch-off of television receiver 220J of the multimedia system 220, informational supply, dispatch, etc. by transmitting and receiving a lightwave signal with a 1 heart bidirectional optical communication type using the optical fiber explained to a home server 203 later.

[0016] Drawing 2 shows an example of the optical transmitter-receiver 1 for connecting a home server 203 between the various devices of the control system 210 shown in drawing 1 , or the multimedia system 220, and with various devices. This optical transmitter-receiver is used for the so-called 1 heart bidirectional optical-communication circuit, and an optical fiber 11 can transmit and receive a lightwave signal between one device M1 and the device M2 of another side. The optical transmitter-receiver 1 is formed in these devices M1 and M2, respectively. These devices M1 and M2 are each device of the control system 210 shown in drawing 1 , each device of the multimedia system 220, and home server 203 grade.

[0017] Drawing 3 and drawing 4 show the gestalt of desirable operation of the optical transmitter-receiver 1 of drawing 2 . This optical transmitter-receiver 1 is for performing 1 heart bidirectional optical communication using an optical fiber 11. Edge 11a of an optical fiber 11 can be inserted in 10f of holes of the connector 10 of the package 7 of the optical transmitter-receiver 1 removable. This optical transmitter-receiver 1 has the photodiode 5 grade as this package 7, the source 2 of laser luminescence as a luminescence means, optical equipment 20, and a light-receiving means. The source 2 of laser luminescence is formed on the semiconductor device 32. It is the semiconductor laser which emits light in laser beam L with a wavelength of 650nm, and this source 2 of laser luminescence is the 1st lightwave signal S1 which this laser beam L tends to transmit after this. The drive of this source 2 of laser luminescence is performed by the laser luminescence drive circuit which is not illustrated, and it drives the source 2 of laser luminescence so that this laser luminescence drive circuit may generate the 1st lightwave signal S1.

[0018] Optical equipment 20 is arranged at the optical path between the source 2 of laser luminescence, and an optical fiber 11. The shaft orientations CL of an optical fiber 11 are perpendicular preferably to the optical axis OP1 of the 1st lightwave signal S1. Optical equipment 20 bends the optical path of the 1st lightwave signal S1, and has the function to which incidence of the 1st lightwave signal S1 is carried out to edge 11a of an optical fiber 11 along the direction shown in an arrow head R1. This optical equipment 20 has the joint lens (condenser lens) 3, base 3a, and the starting mirror 4. This base 3a is fixing the joint lens 3, and the joint lens 3 has met the source 2 of laser luminescence. The starting mirror 4 is located in the backside of the joint lens 3, the starting mirrors 4 are cross-section about 3 square shapes-like, and total reflection film 4a is preferably formed in the inclined plane.

[0019] As for the core of the joint lens 3, and the core of the 1st lightwave signal S1 on the strength, only distance d is shifted although the joint lens 3 is a convex lens which leads the 1st lightwave signal S1 of the source 2 of laser luminescence to the total reflection film 4a side of the starting mirror 4. For this reason, it will be condensed with this joint lens 3, and the 1st lightwave signal S1 which passed along the joint lens 3 can bend the course based on on the strength. It is reflected by total reflection film 4a of the starting mirror 4, and the laser beam signal S11 which could bend this course and it converged serves as a beam of light 8, and carries out incidence aslant at an include angle theta (theta is smaller than 90 degrees) to end-face 11b of edge 11a of an optical fiber 11.

[0020] The photodiode 5 which is a light-receiving means to explain to base 3a of the source 2 of laser luminescence mentioned above, a semi-conductor 32, and optical equipment 20, the starting mirror 4, and a degree is set as the semi-conductor substrate (it is also called a substrate) 6. On the other hand, incidence of the 2nd lightwave signal S2 by which outgoing radiation is carried out from end-face 11b of the optical fiber 11 of drawing 3 is carried out to the direct photodiode 5. That is, in the location corresponding to end-face 11b of an optical fiber 11, as a photodiode 5 is embedded at the semi-conductor substrate 6, it is being fixed to it.

[0021] Next, with reference to drawing 3 and drawing 4 , and drawing 5 , the optical transceiver actuation using the 1st lightwave signal S1 and the 2nd lightwave signal S2 in the optical transmitter-receiver 1 is explained. The 1st lightwave signal S1 with which the source 2 of laser luminescence emitted light is condensed with the joint lens 3. At this time, the course based on [that the core of the 1st lightwave signal S1 on the strength is outgoing radiation light since only the core and distance d of the joint lens 3 have shifted / of the 1st lightwave signal S1] on the strength (chief ray) is bent above the drawing, and it is bent by rising further and being reflected by total reflection film 4a of a mirror 4, becomes the flux of light 8, and goes in the R1 direction.

[0022] And as shown in drawing 4 and drawing 5 , incidence of the flux of light of this 1st lightwave signal S1 is carried out at an angle of theta to end-face 11b of an optical fiber 11. The flux of light 8 which carried out incidence is divided into

beam-of-light 8r reflected by end-face 11b of the 8t of beams of light and the optical fiber 11 which advance into an optical fiber 11. If beam-of-light 8r reflected of these arrives at the light-receiving field of a photodiode 5, since it will become an optical cross talk (stray light) in a photodiode 5, this beam-of-light 8r is reflected toward the direction of an arrow head R2. In end-face 11b, beam-of-light 8r reflects in the direction of R2 to the semi-conductor substrate 6 by angle of reflection theta. This field that reflects and reaches the semi-conductor substrate 6 exists outside the field of the light-receiving field of a photodiode 5. That is, in order to avoid the stray light, beam-of-light 8r can be prevented from going into the light-receiving range of a photodiode 5 at all by choosing the location of a photodiode 5, and the include angle of beam-of-light 8r which progresses aslant. The include angle of end-face 11b of an optical fiber 11 and choosing the degree (effective N.A.: effective numerical aperture) of convergence of beam-of-light 8r further can also realize such effectiveness.

[0023] Thus, by selecting the location to the source 2 of laser luminescence of the joint lens 3, the situation where the 1st lightwave signal S1 generated from the source 2 of laser luminescence returns to the source 2 side of laser luminescence does not occur, and a laser dispatch property is not made unstable. Since antireflection film 5a is formed in the front face of a photodiode 5, the quantity of light of the 2nd lightwave signal S2 is efficiently convertible for the electrical and electric equipment from light. If the total reflection film is formed to side-face 4b of the starting mirror 4, i.e., side-face 4b by the side of a photodiode 5 Even if the 2nd lightwave signal S2 from an optical fiber 11 is the case where it irradiates temporarily at the side-face 4b side of the starting mirror 4 It can be made to be able to reflect with the total reflection film of side-face 4b, and incidence of the 2nd lightwave signal S2 can be carried out to a photodiode 5 side, and it can prevent the fall of the amount of incident light of the 2nd lightwave signal S2. When about 45 degrees of include angles theta 1 theta 1 of the starting mirror 4, i.e., the include angle to the semi-conductor substrate 6, leans and it forms total reflection film 4a to the slant face, the 1st lightwave signal S1 does not produce at all the phenomenon in which the starting mirror 4 is penetrated and a photodiode 5 is reached, either.

[0024] And since beam-of-light 8r of the 1st lightwave signal S1 reaches outside the light-receiving field of a photodiode 5 as shown in drawing 4 when the 2nd lightwave signal S2 is received with a photodiode 5 from an optical fiber 11, in a photodiode 5, the cross talk (stray light) phenomenon over the 2nd lightwave signal S2 does not produce the biggest description. Therefore, the transceiver effectiveness in a transmitter-receiver can be raised. Even if it is the case where do not form total reflection film 4a to the starting mirror 4, but the reflective film which is not total reflection film is formed, the cross talk of the 1st lightwave signal S1 in a photodiode 5 and the 2nd lightwave signal S2 can be prevented mostly.

[0025] The optical path of the 1st lightwave signal S1 and the optical path of the 2nd lightwave signal S2 are completely separable from the above thing. moreover, mere glass -- or only by forming the total reflection film or other reflective film to the starting mirror 4 made from plastics, since incidence of the 1st lightwave signal S1 can be carried out at an include angle theta to end-face 11b of an optical fiber 11, it is not necessary to use a large-sized beam splitter like before, and a manufacturing cost can be lowered.

[0026] Next, an example of the property of an optical fiber is explained with reference to drawing 6 and drawing 7 . Drawing 6 shows an example of the property of an optical fiber 11, the outer diameter of an optical fiber is 1000 micrometers, a covering outer diameter is 2.2mm, and the quality of a cladding material is polyethylene. The optical fiber consists of wrap clads in a core and its core, and the periphery enclosure of the clad is covered in the jacket made qualitatively [of a cladding material] like the polyethylene mentioned above. When the wavelength of the light of the source of laser luminescence is the monochrome parallel light which is 650nm, the transmission loss of an optical fiber 11 is 14dB / 100m, and the band is 160MHz.

[0027] The example of a loss spectrum of that optical fiber is shown in drawing 7 , and it is the semantics of carrying out incidence of the 1st lightwave signal S1 or the 2nd lightwave signal S2 to the end face of an optical fiber numerical-aperture NA=0.1, in excitation NA=0.1 in this. In this case, transmission loss can be suppressed comparatively small in a place with a wavelength of 650nm.

[0028] Next, with reference to drawing 8 etc., the gestalt of another operation of the optical transmitter-receiver of this invention is explained. In addition, about the gestalt of another operation of the optical transmitter-receiver of this invention explained below, a different part from the gestalt of operation of drawing 3 - drawing 5 is explained, the same sign is described in the same part as the gestalt of operation shown in drawing 3 - drawing 5 , and the explanation is omitted. Although the source 2 of laser luminescence, optical equipment 20, and the photodiode 5 grade of the optical transmitter-receiver of drawing 8 are substantially the same, the structures of connector 10a of an optical fiber 11 differ. The connector 10 is equipped with 10f of holes for letting an optical fiber 11 pass, and an optical fiber 11 can make now end-face 11b of an optical fiber 11 meet to a photodiode 5 with the gestalt of operation of drawing 3 by inserting to 10f of this hole.

[0029] On the other hand, from the upper limit section of a package 7, connector area 10a of drawing 8 is projected for example, in the shape of a cylinder, and is formed. Hole 10c of for example, a circle configuration is formed in the upper limit section of this connector area 10a, and edge 11a of an optical fiber 11 can be inserted now to this hole 10c. Light absorption object (or absorption film) 10b as a protection-from-light means is prepared in the inside side of this connector area 10a. This light absorption object 10b is prepared in the corresponding location at which the beam of light 8 reflected by total reflection film 4a of the starting mirror 4 arrives. That is, when an optical fiber 11 extracts in the direction of arrow-head Y from connector area 10a, it prevents a beam of light 8 leaking to the exterior of a package 7 by a beam of light 8 being absorbed by this light absorption object 8b. Thereby, a beam of light 8 comes out of an optical transmitter-receiver, and carries out incidence to people's eye and the skin. It can prevent certainly the beam of light 8 whose source 2 of laser luminescence is a laser beam working when the optical fiber 11 has fallen out [connector area 10a] according to a certain external force

leaking outside.
[0030] If this protection-from-light means is light absorption object 10b, since this beam of light 8 will be absorbed and a beam of light 8 does not carry out incidence to a photodiode 5 as the stray light, it can also be prevented that a cross talk occurs in a photodiode 5. This is realizable by making it that a beam of light 8 progresses aslant to end-face 11b of an optical fiber 11, and a beam of light 8 not spread greatly. Drawing 9 shows the example which prepared 10d of another members in the gestalt of operation of drawing 3 , and equipped light absorption object 10b.
[0031] Next, drawing 10 shows the gestalt of still more nearly another operation of the optical transmitter-receiver of this invention. With the gestalt of operation of drawing 10 , while the joint lens 3 had taken the place of the joint lens 103 compared with the gestalt of operation of drawing 3 , the starting mirror 4 of drawing 3 rose and it was changed to the mirror 104. After being condensed with this joint lens 103, an optical path is bent by total reflection film 104a of the starting mirror 104, and incidence of the 1st lightwave signal S1 which is laser beam [of the source 2 of laser luminescence] L is carried out at an include angle theta to end-face 11b of an optical fiber 11 as a beam of light (incident light) 8 along R1 direction. That is, although the core of a joint lens had shifted only the core on the strength and distance d of the 1st lightwave signal S1 in drawing 3 , in drawing 10 , the core of the joint lens 103 which are the core of the 1st lightwave signal S1 on the strength and a convex lens not right [that] does not shift, but it is in agreement. Therefore, the effect of the aberration of the joint lens 103 can be suppressed, and improvement in optical joint effectiveness can expect further.
[0032] Moreover, the include angle theta 2 of the starting mirror 104 is set as the include angle smaller than 45 degrees, and can be made to incline and irradiate reflected beam-of-light 8r to the semi-conductor substrate 6. By choosing the include angle theta 2 of the starting mirror 104 as arbitration, the location of end-face 11b of an optical fiber 11 can be chosen freely. Of course, the starting mirror 104 of the joint lens 3 of drawing 4 and drawing 10 can also be used together.
[0033] Drawing 11 shows the gestalt of still more nearly another operation of the optical transmitter-receiver of this invention. In drawing 11 , the covering components 12 of transparence are arranged between the group of the source 2 of laser luminescence, optical equipment 20, and a photodiode 5, and the optical fiber 11. This covering component 12 prevents the dust containing from 10f of holes going into the source 2 of laser luminescence, optical equipment 20, and photodiode 5 grade. Although it can make like glass or plastics, even if this covering component 12 is the case where especially this covering component 12 exists between optical equipment 3, a photodiode 5, and an optical fiber 11, it can employ the merit of a beam of light 8 inclining and carrying out incidence at an include angle theta to end-face 11b of an optical fiber 11 efficiently. That is, the antireflection film set by the wavelength of the source 2 of laser luminescence is given to the covering components 12. However, it is technically difficult to make it penetrate to end-face 11b, without reflecting a beam of light 8 100% in the covering components 12, and the beam of light of that reinforcement is reflected in the direction of an arrow head R2 by the covering components 12 what% of the beams of light 8. However, since the beams of light 8r and 8r reflected on the front reverse side of the covering components 12 can also be made to reach outside the field of a photodiode 5 as they avoid the light-receiving side of a photodiode 5, they do not serve as the stray light in a photodiode 5.
[0034] Drawing 12 shows the gestalt of still more nearly another operation of the optical transmitter-receiver of this invention. It is the following point that the gestalt of operation of drawing 12 differs from the gestalt of operation of drawing 11 . In the package 7, the covering components 12 lean only an include angle theta 4, and are arranged. And the medial axis CL leans only an include angle theta 4 to a package 7, and the optical fiber 11 is also arranged. Thus, beam-of-light 8r which the beam of light 8 reflected with the covering components 12 by leaning and arranging the covering components 12 and an optical fiber 11 to a package 7, and beam-of-light 8r reflected by end-face 11b can be made to arrive at fields other than the light-receiving side of a photodiode 5 too. Thus, the cross talk in a photodiode 5 can be prevented. Moreover, as the drawing 12 field (A) shows, if the medial axis CL of an optical fiber 11 leans beforehand 11d of end faces of an optical fiber 11 and they are formed, without leaning, it can prevent the cross talk by beam-of-light 8r in a photodiode 5 similarly.
[0035] Next, with the gestalt of operation of the optical transmitter-receiver of this invention of drawing 13 , the condenser lens (condensing component) 13 is arranged between end-face 11b of an optical fiber 11, and a photodiode 5. Thereby, since light is received by the photodiode 5 after being condensed with a lens 13, the 2nd lightwave signal S2 by which outgoing radiation was carried out from the optical fiber 11 can raise the optical joint effectiveness of the 2nd lightwave signal S2 and a photodiode 5.
[0036] With the gestalt of operation of the optical transmitter-receiver of this invention shown in drawing 14 , the starting mirror 4 and the joint lens 3 in optical equipment 20 are unified. The function which optical equipment 20 bends the optical path of the 1st lightwave signal S1, and makes a beam of light 8 is the same as the optical equipment 20 of drawing 3 . Thus, by rising with the joint lens 3 and unifying a mirror 4, components mark can be reduced, moreover, optical equipment 20 can be attached by one adhesion to the semi-conductor substrate 6, it rises with a joint lens, and the optical alignment of a mirror becomes unnecessary.
[0037] With the gestalt of operation of the optical transmitter-receiver of this invention of drawing 15 , the joint lens 3 is arranged at the transparent covering components 12. That is, although optical equipment 20 consists of a joint lens 3 and a starting mirror 4, the joint lens 3 is arranged united with the covering components 12 between end-face 11b of the starting mirror 4 and an optical fiber 11. After being reflected by total reflection film 4a of the starting mirror 4, as a result of being condensed with a condenser lens 3, incidence of the 1st lightwave signal S1 of the source 2 of laser luminescence is aslant carried out as incident light at an angle of predetermined to end-face 11b of an optical fiber 11.
[0038] With the gestalt of operation of the optical transmitter-receiver of this invention of drawing 16 , optical equipment 20 has not only the 1st lightwave signal S1 but the function to draw the 2nd lightwave signal S2. A part for a core on the strength

is bent by total reflection film 4a of the starting mirror 4 which has the same function as the joint lens 3 shown in drawing 3 , the joint lens 3 which has the same function, and the starting mirror 4 shown in drawing 3 , the 1st lightwave signal S1 serves as a beam of light 8, and incidence of this beam of light 8 is carried out to end-face 11b of an optical fiber 11 by the include angle theta along arrow-head R1 direction. On the other hand, the 2nd lightwave signal S2 which has passed along the optical fiber 11 will pass along prism 4c of optical equipment 20, and will be received to the light-receiving side of a photodiode 5.

[0039] Drawing 17 shows the gestalt of still more nearly another operation of this invention, and incidence of the 1st lightwave signal S1 of the source 2 of laser luminescence is aslant carried out at an angle of theta to end-face 11b of the direct optical fiber 11 through the joint lens 3 (convex lens) of optical equipment 20. That is, the starting mirror 4 grade explained so far is made unnecessary.

[0040] The cross talk generated in the gestalt of operation of this invention when it not only can gather the optical joint effectiveness to the photodiode from an optical fiber, but the reflected light of the 1st lightwave signal carries out incidence to a photodiode with the 2nd lightwave signal as explained above can be prevented. that is, the joint effectiveness at the time of the 2nd lightwave signal being received with a photodiode is improved -- it can make -- a cross talk (stray light) -- reduction -- or it can lose. Since it is not necessary to use the large-sized beam splitter used conventionally, cost can be lowered.

[0041] In the gestalt of operation of this invention, there is the following effectiveness by dividing nearly completely the optical path which carries out incidence to an optical fiber from the light source when performing 1 heart bidirectional optical communication using an optical fiber, and the optical path which carries out incidence to a light-receiving means from an optical fiber.

(1) The cross talk of the 1st lightwave signal S1 for transmission and the 2nd lightwave signal S2 for reception can be reduced.

(2) The optical joint effectiveness of an optical fiber and a light-receiving means can be gathered.

[0042] By the way, this invention is not limited to the gestalt of the above-mentioned implementation. With the gestalt of operation mentioned above, the gestalt of operation of the optical transmitter-receiver of this invention is used for construction of the network of a control system for home use or a multimedia system. However, the optical transmitter-receiver of this invention is applicable to the communication system for exchanging various information in mobiles, such as not only this but an automobile, an airplane, a ship, etc., etc. Moreover, of course, not only 650nm but the thing for which other wavelength fields are used is possible for the wavelength of the source of laser luminescence as a luminescence means. And, of course as a luminescence means, not only the source of laser luminescence but the thing for which the source of luminescence of other classes is used is possible. When attaching an optical fiber to a package, of course, the maintenance means which positions an optical fiber to a package and can be prevented from moving to the shaft orientations of an optical fiber is established.

[0043]

[Effect of the Invention] As explained above, according to this invention, generating of the cross talk in the case of performing optical transmission and reception can be prevented, and optical transceiver effectiveness can be gathered.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention relates to the optical transmitter-receiver and the optical transceiver approach for 1 heart bidirectional optical communication.

[Translation done.]

PRIOR ART

[Description of the Prior Art] The method which transmits a signal by optical communication greets diversification of an information communication link, and its need is increasing increasingly. When transmitting a signal by optical communication, the two-way communication circuit method of 1 heart method which usually used one optical fiber, and the two-way communication circuit method of 2 heart methods using two optical fibers are used. The optical transmitter-receiver as shown in drawing 18 is used for the 1 heart bidirectional optical communication type. The conventional optical transmitter-receiver shown in drawing 18 needs to divide the optical path of optical transmission and optical reception, in order to realize 1 heart bidirectional optical communication. The optical path for transmission is an optical path which the light which carried out outgoing radiation from the source 1002 of laser luminescence is bent by reflector 1004a of a beam splitter 1004, passes along the joint lens 1003, and carries out incidence to edge 1011a of an optical fiber 1011.
[0003] The optical path for reception is an optical path which it is condensed with the joint lens 1003, and the outgoing radiation light from an optical fiber 1011 penetrates reflector 1004a of a beam splitter 1004, and carries out incidence to a photodiode 1005. That is, in order to divide the optical path the object for transmission, and for reception, the beam splitter 1004 is used.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, according to this invention, generating of the cross talk in the case of performing optical transmission and reception can be prevented, and optical transceiver effectiveness can be gathered.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Thus, at the time of transmission, the light from the source 1002 of laser luminescence is reflected by reflector 1004a of a beam splitter 1004. However, when this light is reflected, what percent, that light penetrates reflector 1004a and enters as direct stray light 1008a into a beam splitter 1004. Thus, incidence of the stray light 1008a which entered into the beam splitter 1004 will be carried out also to a photodiode 1005. That is, a photodiode 1005 not only receives the light for reception by which outgoing radiation is carried out from the usual optical fiber 1011, but stray light 1008a as a cross talk will receive it. If this stray light 1008a carries out incidence to a photodiode 1005, S/N (a signal/noise) of a photodiode 1005 will deteriorate, and the transmission distance by the optical fiber 1011 will become short. [0005] Although there is also an example which replaces with and uses for a beam splitter 1004 the polarization beam splitter doubled with oscillation polarization of the source 1002 of laser luminescence in another conventional example, since a laser beam is not the perfect linearly polarized light, generating of stray light 1008a at the time of transmission cannot be completely abolished in this case. moreover -- since it is reflected by reflector (mirror plane) 1004a of a beam splitter 1004 also when a photodiode 1005 receives the outgoing radiation light from an optical fiber 1011 -- the light for the reception -- what percent, that part did not reach a photodiode 1005 but is made useless. The receiving light reflected by reflector 1004a of a beam splitter 1004 may carry out incidence to the source 1002 of laser luminescence, and may make unstable the oscillation property of the source 1002 of laser luminescence. Then, this invention cancels the above-mentioned technical problem, and prevents generating of the cross talk in the case of performing optical transmission and reception in a 1 heart bidirectional optical-communication circuit, and it aims at offering the optical transmitter-receiver and the optical transceiver approach of gathering optical transceiver effectiveness.

[Translation done.]

MEANS

[Means for Solving the Problem] If the above-mentioned purpose is in this invention, while making the edge of said optical fiber carry out incidence of the 1st lightwave signal which it connects with the optical fiber used for a 1 heart bidirectional optical-communication circuit, and is going to transmit The luminescence means which is an optical transmitter-receiver for receiving the 2nd lightwave signal sent through said optical fiber, and carries out outgoing radiation of said 1st lightwave signal, A light-receiving means to receive said 2nd lightwave signal which carries out outgoing radiation from said edge of said optical fiber, The optical equipment to which said 2nd lightwave signal meets in the different direction from the direction which carries out outgoing radiation from said edge of said optical fiber, and the incidence edge of said optical fiber is made to carry out incidence of said 1st lightwave signal of said luminescence means, It is attained by the optical transmitter-receiver characterized by arranging said light-receiving means outside the field at which the reflected light produced because said 1st lightwave signal reflects at said edge of said optical fiber arrives, when it **** and the edge of an optical fiber is made to carry out incidence of said 1st lightwave signal.

[0007] This invention is an optical transmitter-receiver which receives the 2nd lightwave signal sent through this optical fiber while making the edge of an optical fiber carry out incidence of the 1st lightwave signal which it connects with the optical fiber used for a 1 heart bidirectional optical-communication circuit, and is going to transmit. The luminescence means of this optical transmitter-receiver carries out outgoing radiation of the 1st lightwave signal. A light-receiving means receives the 2nd lightwave signal which carries out outgoing radiation from the edge of an optical fiber. The 2nd lightwave signal makes the incidence edge of an optical fiber, as for optical equipment, carry out incidence of the 1st lightwave signal of a luminescence means along a different direction from the direction which carries out outgoing radiation from the edge of an optical fiber. Thereby, since the 2nd lightwave signal makes the edge of an optical fiber carry out incidence of the 1st lightwave signal of a luminescence means along a different direction from the direction which carries out outgoing radiation from the edge of an optical fiber, the optical path of the 1st lightwave signal and the optical path of the 2nd lightwave signal can be made to become independent nearly completely with optical equipment. From this, since a part of 1st lightwave signal does not receive light for a light-receiving means with the 2nd lightwave signal, the optical cross talk (stray light) in a light-receiving means can be lost. In this invention, if the light-receiving means is arranged outside the field at which the reflected light produced because the 1st lightwave signal reflects at the edge of an optical fiber arrives when the edge of an optical fiber is made to carry out incidence of the 1st lightwave signal preferably, prevention of generating of a cross talk (stray light) can be ensured.

[0008] In this invention, preferably, by optical equipment being equipped with a condensing member and a directional change component, after a condensing member condenses the 1st lightwave signal of a luminescence means, a directional change component can change it in the different direction from the direction where the 2nd lightwave signal carries out outgoing radiation of the optical path of the 1st lightwave signal which condensed from the edge of an optical fiber, and can carry out incidence to the edge of an optical fiber. Thereby, the edge of an optical fiber can be made to carry out incidence of the 1st lightwave signal of a luminescence means efficiently. Though it is an easy configuration, it can make it carry out incidence of the 1st lightwave signal to the edge of an optical fiber efficiently certainly preferably, in this invention, if it is made for the directional change component of optical equipment to have the reflective film in a reflector for the 2nd lightwave signal to change the optical path of the 1st lightwave signal in the direction in which the directions which carry out outgoing radiation from the edge of an optical fiber differ.

[0009] And if this reflective film is total reflection film preferably, there is no loss of the quantity of light of the 1st lightwave signal, and the edge of an optical fiber can be made to carry out incidence in this invention. If the edge of an optical fiber is turned to a light-receiving means and it is made to be attached in this package removable, an optical fiber can be easily detached [it has the package which holds a luminescence means, optical equipment, and a light-receiving means, and] in this invention, and attached to an optical transmitter-receiver. In this invention, if the protection-from-light means is arranged in the package in order to prevent the light of a luminescence means leaking from a package preferably, even if it is the case where an optical fiber separates from a package, it can prevent the light of a luminescence means leaking from a package outside.

[0010] In this invention, if it has the condensing component in order to condense the 2nd lightwave signal preferably and to carry out incidence to a light-receiving means, the incidence effectiveness over the light-receiving means of the 2nd lightwave signal can be gathered.

[0011] If the above-mentioned purpose is in this invention, while making the edge of said optical fiber carry out incidence of the 1st lightwave signal which it connects with the optical fiber used for a 1 heart bidirectional optical-communication circuit,

and is going to transmit It is the optical transceiver approach for receiving the 2nd lightwave signal sent through said optical fiber. Said 2nd lightwave signal meets in the different direction from the direction which carries out outgoing radiation from said edge of said optical fiber. While receiving said 2nd lightwave signal in which is made to carry out incidence of said 1st lightwave signal of a luminescence means to said edge of said optical fiber, and a light-receiving means carries out outgoing radiation from said edge of said optical fiber It is attained by the optical transceiver approach characterized by not receiving the reflected light in said edge of said optical fiber of said 1st lightwave signal.

[0012] Since the 2nd lightwave signal makes the edge of an optical fiber by this carry out incidence of the 1st lightwave signal of a luminescence means along a different direction from the direction which carries out outgoing radiation from the edge of an optical fiber, the optical path of the 1st lightwave signal and the optical path of the 2nd lightwave signal can be made to become independent nearly completely. Since the optical cross talk (stray light) in a light-receiving means can be lost since a part of 1st lightwave signal is not received by the light-receiving means with the 2nd lightwave signal, and the reflected light in the edge of the optical fiber of the 1st lightwave signal is not received, the optical stock in a light-receiving means can be protected from this still more certainly.

[0013]

[Embodiment of the Invention] Hereafter, the gestalt of suitable operation of this invention is explained to a detail based on an accompanying drawing. In addition, since the gestalt of the operation described below is the suitable example of this invention, desirable various limitation is attached technically, but especially the range of this invention is not restricted to these gestalten, as long as there is no publication of the purport which limits this invention in the following explanation.

[0014] The example which connected in the network the home which drawing 1 considers as the object which can apply the optical transmitter-receiver of this invention, for example, is called the so-called KONEKUTIDDO home (Connected Home) with the information provider in the world is shown. In the house 200, various electrical machinery and apparatus, information machines and equipment, etc. are arranged. Through the external contents provider 201 to the access network 202, a home server 203 can be provided with information, or a house 200 can send information now to the contents provider 201 side through the access network 202 from a home server 203. Moreover, the antenna 204 is formed in the house 200 and the information from the contents provider 201 can be received now through a satellite 205. The method using the ground wave as the method of informational offer is also employable.

[0015] In the house 200 of drawing 1 , the control system 210 and the multimedia system 220 of the device mentioned above are prepared. In the control system 210, the signal path for controlling the device used at ordinary homes, for example, electric light 210A, refrigerator 210B, microwave oven 210C, interior unit 210D of an air-conditioner, electric carpet 210E, gas hot-water supply machine 210F, and the device 210G grade for remote medical treatments is formed. On the other hand, the multimedia system 220 forms the signal path which controls device corresponding to multimedia age, for example, computer 220A, telephone 220B, audio equipment 220C, pocket mold information-machines-and-equipment 220D, and digital still camera 220E, printer facsimile 220F, digital camcorder 220G, game machine 220H, and DVD (digital-versatile-disc [or] digital videodisc: trademark) player 220I, and television receiver 220J grade. The various devices of these control systems 210 and multimedia systems 220 can perform on-off control of each device of a control system 210, supply of the information on various devices, etc., or can operate now switch-on and switch-off of television receiver 220J of the multimedia system 220, informational supply, dispatch, etc. by transmitting and receiving a lightwave signal with a 1 heart bidirectional optical communication type using the optical fiber explained to a home server 203 later.

[0016] Drawing 2 shows an example of the optical transmitter-receiver 1 for connecting a home server 203 between the various devices of the control system 210 shown in drawing 1 , or the multimedia system 220, and with various devices. This optical transmitter-receiver is used for the so-called 1 heart bidirectional optical-communication circuit, and an optical fiber 11 can transmit and receive a lightwave signal between one device M1 and the device M2 of another side. The optical transmitter-receiver 1 is formed in these devices M1 and M2, respectively. These devices M1 and M2 are each device of the control system 210 shown in drawing 1 , each device of the multimedia system 220, and home server 203 grade.

[0017] Drawing 3 and drawing 4 show the gestalt of desirable operation of the optical transmitter-receiver 1 of drawing 2 . This optical transmitter-receiver 1 is for performing 1 heart bidirectional optical communication using an optical fiber 11. Edge 11a of an optical fiber 11 can be inserted in 10f of holes of the connector 10 of the package 7 of the optical transmitter-receiver 1 removable. This optical transmitter-receiver 1 has the photodiode 5 grade as this package 7, the source 2 of laser luminescence as a luminescence means, optical equipment 20, and a light-receiving means. The source 2 of laser luminescence is formed on the semiconductor device 32. It is the semiconductor laser which emits light in laser beam L with a wavelength of 650nm, and this source 2 of laser luminescence is the 1st lightwave signal S1 which this laser beam L tends to transmit after this. The drive of this source 2 of laser luminescence is performed by the laser luminescence drive circuit which is not illustrated, and it drives the source 2 of laser luminescence so that this laser luminescence drive circuit may generate the 1st lightwave signal S1.

[0018] Optical equipment 20 is arranged at the optical path between the source 2 of laser luminescence, and an optical fiber 11. The shaft orientations CL of an optical fiber 11 are perpendicular preferably to the optical axis OP1 of the 1st lightwave signal S1. Optical equipment 20 bends the optical path of the 1st lightwave signal S1, and has the function to which incidence of the 1st lightwave signal S1 is carried out to edge 11a of an optical fiber 11 along the direction shown in an arrow head R1. This optical equipment 20 has the joint lens (condenser lens) 3, base 3a, and the starting mirror 4. This base 3a is fixing the joint lens 3, and the joint lens 3 has met the source 2 of laser luminescence. The starting mirror 4 is located in the backside of the joint lens 3, the starting mirrors 4 are cross-section about 3 square shapes-like, and total reflection film 4a is preferably

formed in the inclined plane.
[0019] As for the core of the joint lens 3, and the core of the 1st lightwave signal S1 on the strength, only distance d is shifted although the joint lens 3 is a convex lens which leads the 1st lightwave signal S1 of the source 2 of laser luminescence to the total reflection film 4a side of the starting mirror 4. For this reason, it will be condensed with this joint lens 3, and the 1st lightwave signal S1 which passed along the joint lens 3 can bend the course based on on the strength. It is reflected by total reflection film 4a of the starting mirror 4, and the laser beam signal S11 which could bend this course and it converged serves as a beam of light 8, and carries out incidence aslant at an include angle theta (theta is smaller than 90 degrees) to end-face 11b of edge 11a of an optical fiber 11.
[0020] The photodiode 5 which is a light-receiving means to explain to base 3a of the source 2 of laser luminescence mentioned above, a semi-conductor 32, and optical equipment 20, the starting mirror 4, and a degree is set as the semi-conductor substrate (it is also called a substrate) 6. On the other hand, incidence of the 2nd lightwave signal S2 by which outgoing radiation is carried out from end-face 11b of the optical fiber 11 of drawing 3 is carried out to the direct photodiode 5. That is, in the location corresponding to end-face 11b of an optical fiber 11, as a photodiode 5 is embedded at the semi-conductor substrate 6, it is being fixed to it.
[0021] Next, with reference to drawing 3 and drawing 4 , and drawing 5 , the optical transceiver actuation using the 1st lightwave signal S1 and the 2nd lightwave signal S2 in the optical transmitter-receiver 1 is explained. The 1st lightwave signal S1 with which the source 2 of laser luminescence emitted light is condensed with the joint lens 3. At this time, the course based on [that the core of the 1st lightwave signal S1 on the strength is outgoing radiation light since only the core and distance d of the joint lens 3 have shifted / of the 1st lightwave signal S1] on the strength (chief ray) is bent above the drawing, and it is bent by rising further and being reflected by total reflection film 4a of a mirror 4, becomes the flux of light 8, and goes in the R1 direction.
[0022] And as shown in drawing 4 and drawing 5 , incidence of the flux of light of this 1st lightwave signal S1 is carried out at an angle of theta to end-face 11b of an optical fiber 11. The flux of light 8 which carried out incidence is divided into beam-of-light 8r reflected by end-face 11b of the 8t of beams of light and the optical fiber 11 which advance into an optical fiber 11. If beam-of-light 8r reflected of these arrives at the light-receiving field of a photodiode 5, since it will become an optical cross talk (stray light) in a photodiode 5, this beam-of-light 8r is reflected toward the direction of an arrow head R2. In end-face 11b, beam-of-light 8r reflects in the direction of R2 to the semi-conductor substrate 6 by angle of reflection theta. This field that reflects and reaches the semi-conductor substrate 6 exists outside the field of the light-receiving field of a photodiode 5. That is, in order to avoid the stray light, beam-of-light 8r can be prevented from going into the light-receiving range of a photodiode 5 at all by choosing the location of a photodiode 5, and the include angle of beam-of-light 8r which progresses aslant. The include angle of end-face 11b of an optical fiber 11 and choosing the degree (effective N.A.: effective numerical aperture) of convergence of beam-of-light 8r further can also realize such effectiveness.
[0023] Thus, by selecting the location to the source 2 of laser luminescence of the joint lens 3, the situation where the 1st lightwave signal S1 generated from the source 2 of laser luminescence returns to the source 2 side of laser luminescence does not occur, and a laser dispatch property is not made unstable. Since antireflection film 5a is formed in the front face of a photodiode 5, the quantity of light of the 2nd lightwave signal S2 is efficiently convertible for the electrical and electric equipment from light. If the total reflection film is formed to side-face 4b of the starting mirror 4, i.e., side-face 4b by the side of a photodiode 5 Even if the 2nd lightwave signal S2 from an optical fiber 11 is the case where it irradiates temporarily at the side-face 4b side of the starting mirror 4 It can be made to be able to reflect with the total reflection film of side-face 4b, and incidence of the 2nd lightwave signal S2 can be carried out to a photodiode 5 side, and it can prevent the fall of the amount of incident light of the 2nd lightwave signal S2. When about 45 degrees of include angles theta 1 theta 1 of the starting mirror 4, i.e., the include angle to the semi-conductor substrate 6, leans and it forms total reflection film 4a to the slant face, the 1st lightwave signal S1 does not produce at all the phenomenon in which the starting mirror 4 is penetrated and a photodiode 5 is reached, either.
[0024] And since beam-of-light 8r of the 1st lightwave signal S1 reaches outside the light-receiving field of a photodiode 5 as shown in drawing 4 when the 2nd lightwave signal S2 is received with a photodiode 5 from an optical fiber 11, in a photodiode 5, the cross talk (stray light) phenomenon over the 2nd lightwave signal S2 does not produce the biggest description. Therefore, the transceiver effectiveness in a transmitter-receiver can be raised. Even if it is the case where do not form total reflection film 4a to the starting mirror 4, but the reflective film which is not total reflection film is formed, the cross talk of the 1st lightwave signal S1 in a photodiode 5 and the 2nd lightwave signal S2 can be prevented mostly.
[0025] The optical path of the 1st lightwave signal S1 and the optical path of the 2nd lightwave signal S2 are completely separable from the above thing. moreover, mere glass -- or only by forming the total reflection film or other reflective film to the starting mirror 4 made from plastics, since incidence of the 1st lightwave signal S1 can be carried out at an include angle theta to end-face 11b of an optical fiber 11, it is not necessary to use a large-sized beam splitter like before, and a manufacturing cost can be lowered.
[0026] Next, an example of the property of an optical fiber is explained with reference to drawing 6 and drawing 7 . Drawing 6 shows an example of the property of an optical fiber 11, the outer diameter of an optical fiber is 1000 micrometers, a covering outer diameter is 2.2mm, and the quality of a cladding material is polyethylene. The optical fiber consists of wrap clads in a core and its core, and the periphery enclosure of the clad is covered in the jacket made qualitatively [of a cladding material] like the polyethylene mentioned above. When the wavelength of the light of the source of laser luminescence is the monochrome parallel light which is 650nm, the transmission loss of an optical fiber 11 is 14dB / 100m, and the band is

160MHz.
[0027] The example of a loss spectrum of that optical fiber is shown in drawing 7 , and it is the semantics of carrying out incidence of the 1st lightwave signal S1 or the 2nd lightwave signal S2 to the end face of an optical fiber numerical-aperture NA=0.1, in excitation NA=0.1 in this. In this case, transmission loss can be suppressed comparatively small in a place with a wavelength of 650nm.
[0028] Next, with reference to drawing 8 etc., the gestalt of another operation of the optical transmitter-receiver of this invention is explained. In addition, about the gestalt of another operation of the optical transmitter-receiver of this invention explained below, a different part from the gestalt of operation of drawing 3 - drawing 5 is explained, the same sign is described in the same part as the gestalt of operation shown in drawing 3 - drawing 5 , and the explanation is omitted. Although the source 2 of laser luminescence, optical equipment 20, and the photodiode 5 grade of the optical transmitter-receiver of drawing 8 are substantially the same, the structures of connector 10a of an optical fiber 11 differ. The connector 10 is equipped with 10f of holes for letting an optical fiber 11 pass, and an optical fiber 11 can make now end-face 11b of an optical fiber 11 meet to a photodiode 5 with the gestalt of operation of drawing 3 by inserting to 10f of this hole.
[0029] On the other hand, from the upper limit section of a package 7, connector area 10a of drawing 8 is projected for example, in the shape of a cylinder, and is formed. Hole 10c of for example, a circle configuration is formed in the upper limit section of this connector area 10a, and edge 11a of an optical fiber 11 can be inserted now to this hole 10c. Light absorption object (or absorption film) 10b as a protection-from-light means is prepared in the inside side of this connector area 10a. This light absorption object 10b is prepared in the corresponding location at which the beam of light 8 reflected by total reflection film 4a of the starting mirror 4 arrives. That is, when an optical fiber 11 extracts in the direction of arrow-head Y from connector area 10a, it prevents a beam of light 8 leaking to the exterior of a package 7 by a beam of light 8 being absorbed by this light absorption object 8b. Thereby, a beam of light 8 comes out of an optical transmitter-receiver, and carries out incidence to people's eye and the skin. It can prevent certainly the beam of light 8 whose source 2 of laser luminescence is a laser beam working when the optical fiber 11 has fallen out [connector area 10a] according to a certain external force leaking outside.
[0030] If this protection-from-light means is light absorption object 10b, since this beam of light 8 will be absorbed and a beam of light 8 does not carry out incidence to a photodiode 5 as the stray light, it can also be prevented that a cross talk occurs in a photodiode 5. This is realizable by making it that a beam of light 8 progresses aslant to end-face 11b of an optical fiber 11, and a beam of light 8 not spread greatly. Drawing 9 shows the example which prepared 10d of another members in the gestalt of operation of drawing 3 , and equipped light absorption object 10b.
[0031] Next, drawing 10 shows the gestalt of still more nearly another operation of the optical transmitter-receiver of this invention. With the gestalt of operation of drawing 10 , while the joint lens 3 had taken the place of the joint lens 103 compared with the gestalt of operation of drawing 3 , the starting mirror 4 of drawing 3 rose and it was changed to the mirror 104. After being condensed with this joint lens 103, an optical path is bent by total reflection film 104a of the starting mirror 104, and incidence of the 1st lightwave signal S1 which is laser beam [of the source 2 of laser luminescence] L is carried out at an include angle theta to end-face 11b of an optical fiber 11 as a beam of light (incident light) 8 along R1 direction. That is, although the core of a joint lens had shifted only the core on the strength and distance d of the 1st lightwave signal S1 in drawing 3 , in drawing 10 , the core of the joint lens 103 which are the core of the 1st lightwave signal S1 on the strength and a convex lens not right [that] does not shift, but it is in agreement. Therefore, the effect of the aberration of the joint lens 103 can be suppressed, and improvement in optical joint effectiveness can expect further.
[0032] Moreover, the include angle theta 2 of the starting mirror 104 is set as the include angle smaller than 45 degrees, and can be made to incline and irradiate reflected beam-of-light 8r to the semi-conductor substrate 6. By choosing the include angle theta 2 of the starting mirror 104 as arbitration, the location of end-face 11b of an optical fiber 11 can be chosen freely. Of course, the starting mirror 104 of the joint lens 3 of drawing 4 and drawing 10 can also be used together.
[0033] Drawing 11 shows the gestalt of still more nearly another operation of the optical transmitter-receiver of this invention. In drawing 11 , the covering components 12 of transparence are arranged between the group of the source 2 of laser luminescence, optical equipment 20, and a photodiode 5, and the optical fiber 11. This covering component 12 prevents the dust containing from 10f of holes going into the source 2 of laser luminescence, optical equipment 20, and photodiode 5 grade. Although it can make like glass or plastics, even if this covering component 12 is the case where especially this covering component 12 exists between optical equipment 3, a photodiode 5, and an optical fiber 11, it can employ the merit of a beam of light 8 inclining and carrying out incidence at an include angle theta to end-face 11b of an optical fiber 11 efficiently. That is, the antireflection film set by the wavelength of the source 2 of laser luminescence is given to the covering components 12. However, it is technically difficult to make it penetrate to end-face 11b, without reflecting a beam of light 8 100% in the covering components 12, and the beam of light of that reinforcement is reflected in the direction of an arrow head R2 by the covering components 12 what% of the beams of light 8. However, since the beams of light 8r and 8r reflected on the front reverse side of the covering components 12 can also be made to reach outside the field of a photodiode 5 as they avoid the light-receiving side of a photodiode 5, they do not serve as the stray light in a photodiode 5.
[0034] Drawing 12 shows the gestalt of still more nearly another operation of the optical transmitter-receiver of this invention. It is the following point that the gestalt of operation of drawing 12 differs from the gestalt of operation of drawing 11 . In the package 7, the covering components 12 lean only an include angle theta 4, and are arranged. And the medial axis CL leans only an include angle theta 4 to a package 7, and the optical fiber 11 is also arranged. Thus, beam-of-light 8r which the beam of light 8 reflected with the covering components 12 by leaning and arranging the covering components 12 and an optical

fiber 11 to a package 7, and beam-of-light 8r reflected by end-face 11b can be made to arrive at fields other than the light-receiving side of a photodiode 5 too. Thus, the cross talk in a photodiode 5 can be prevented. Moreover, as the drawing 12 field (A) shows, if the medial axis CL of an optical fiber 11 leans beforehand 11d of end faces of an optical fiber 11 and they are formed, without leaning, it can prevent the cross talk by beam-of-light 8r in a photodiode 5 similarly.

[0035] Next, with the gestalt of operation of the optical transmitter-receiver of this invention of drawing 13 , the condenser lens (condensing component) 13 is arranged between end-face 11b of an optical fiber 11, and a photodiode 5. Thereby, since light is received by the photodiode 5 after being condensed with a lens 13, the 2nd lightwave signal S2 by which outgoing radiation was carried out from the optical fiber 11 can raise the optical joint effectiveness of the 2nd lightwave signal S2 and a photodiode 5.

[0036] With the gestalt of operation of the optical transmitter-receiver of this invention shown in drawing 14 , the starting mirror 4 and the joint lens 3 in optical equipment 20 are unified. The function which optical equipment 20 bends the optical path of the 1st lightwave signal S1, and makes a beam of light 8 is the same as the optical equipment 20 of drawing 3 . Thus, by rising with the joint lens 3 and unifying a mirror 4, components mark can be reduced, moreover, optical equipment 20 can be attached by one adhesion to the semi-conductor substrate 6, it rises with a joint lens, and the optical alignment of a mirror becomes unnecessary.

[0037] With the gestalt of operation of the optical transmitter-receiver of this invention of drawing 15 , the joint lens 3 is arranged at the transparent covering components 12. That is, although optical equipment 20 consists of a joint lens 3 and a starting mirror 4, the joint lens 3 is arranged united with the covering components 12 between end-face 11b of the starting mirror 4 and an optical fiber 11. After being reflected by total reflection film 4a of the starting mirror 4, as a result of being condensed with a condenser lens 3, incidence of the 1st lightwave signal S1 of the source 2 of laser luminescence is aslant carried out as incident light at an angle of predetermined to end-face 11b of an optical fiber 11.

[0038] With the gestalt of operation of the optical transmitter-receiver of this invention of drawing 16 , optical equipment 20 has not only the 1st lightwave signal S1 but the function to draw the 2nd lightwave signal S2. A part for a core on the strength is bent by total reflection film 4a of the starting mirror 4 which has the same function as the joint lens 3 shown in drawing 3 , the joint lens 3 which has the same function, and the starting mirror 4 shown in drawing 3 , the 1st lightwave signal S1 serves as a beam of light 8, and incidence of this beam of light 8 is carried out to end-face 11b of an optical fiber 11 by the include angle theta along arrow-head R1 direction. On the other hand, the 2nd lightwave signal S2 which has passed along the optical fiber 11 will pass along prism 4c of optical equipment 20, and will be received to the light-receiving side of a photodiode 5.

[0039] Drawing 17 shows the gestalt of still more nearly another operation of this invention, and incidence of the 1st lightwave signal S1 of the source 2 of laser luminescence is aslant carried out at an angle of theta to end-face 11b of the direct optical fiber 11 through the joint lens 3 (convex lens) of optical equipment 20. That is, the starting mirror 4 grade explained so far is made unnecessary.

[0040] The cross talk generated in the gestalt of operation of this invention when it not only can gather the optical joint effectiveness to the photodiode from an optical fiber, but the reflected light of the 1st lightwave signal carries out incidence to a photodiode with the 2nd lightwave signal as explained above can be prevented. that is, the joint effectiveness at the time of the 2nd lightwave signal being received with a photodiode is improved -- it can make -- a cross talk (stray light) -- reduction -- or it can lose. Since it is not necessary to use the large-sized beam splitter used conventionally, cost can be lowered.

[0041] In the gestalt of operation of this invention, there is the following effectiveness by dividing nearly completely the optical path which carries out incidence to an optical fiber from the light source when performing 1 heart bidirectional optical communication using an optical fiber, and the optical path which carries out incidence to a light-receiving means from an optical fiber.

(1) The cross talk of the 1st lightwave signal S1 for transmission and the 2nd lightwave signal S2 for reception can be reduced.

(2) The optical joint effectiveness of an optical fiber and a light-receiving means can be gathered.

[0042] By the way, this invention is not limited to the gestalt of the above-mentioned implementation. With the gestalt of operation mentioned above, the gestalt of operation of the optical transmitter-receiver of this invention is used for construction of the network of a control system for home use or a multimedia system. However, the optical transmitter-receiver of this invention is applicable to the communication system for exchanging various information in mobiles, such as not only this but an automobile, an airplane, a ship, etc., etc. Moreover, of course, not only 650nm but the thing for which other wavelength fields are used is possible for the wavelength of the source of laser luminescence as a luminescence means. And, of course as a luminescence means, not only the source of laser luminescence but the thing for which the source of luminescence of other classes is used is possible. When attaching an optical fiber to a package, of course, the maintenance means which positions an optical fiber to a package and can be prevented from moving to the shaft orientations of an optical fiber is established.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing showing the example used for the domestic information communication link of a control system or a multimedia system as an example which can apply the optical transmitter-receiver and the optical transceiver approach of this invention.
[Drawing 2] Drawing showing briefly an example by which the optical transmitter-receiver of this invention is arranged between devices.
[Drawing 3] The sectional view showing the gestalt of desirable operation of the optical transmitter-receiver of this invention.
[Drawing 4] Drawing showing signs that the light reflected by the end face of an optical fiber has arrived at fields other than the light-receiving field of a photodiode in the gestalt of operation of drawing 3 .
[Drawing 5] The perspective view showing the gestalt of operation of an optical transmitter-receiver shown in drawing 4 and drawing 5 .
[Drawing 6] Drawing showing an example of the property of an optical fiber.
[Drawing 7] Drawing showing the example of the loss spectrum of an optical fiber.
[Drawing 8] Drawing showing the gestalt of another operation of the optical transmitter-receiver of this invention.
[Drawing 9] Drawing showing the gestalt of another operation of the optical transmitter-receiver of this invention.
[Drawing 10] Drawing showing the gestalt of another operation of the optical transmitter-receiver of this invention.
[Drawing 11] Drawing showing the gestalt of another operation of the optical transmitter-receiver of this invention.
[Drawing 12] Drawing showing the gestalt of another operation of the optical transmitter-receiver of this invention.
[Drawing 13] Drawing showing the gestalt of another operation of the optical transmitter-receiver of this invention.
[Drawing 14] Drawing showing the gestalt of another operation of the optical transmitter-receiver of this invention.
[Drawing 15] Drawing showing the gestalt of another operation of the optical transmitter-receiver of this invention.
[Drawing 16] Drawing showing the gestalt of another operation of the optical transmitter-receiver of this invention.
[Drawing 17] Drawing showing the gestalt of another operation of the optical transmitter-receiver of this invention.
[Drawing 18] Drawing showing the conventional optical transmitter-receiver.
[Description of Notations]
1 [... The starting mirror of optical equipment, 5 / ... A photodiode (light-receiving means), 7 / ... A package, 8 / ... A beam of light (incident light), 11 / ... An optical fiber, 11a / ... An edge, 11b / ... The end face of an optical fiber, 20 / ... Optical equipment, S1 / ... The 1st lightwave signal, S2 / ... The 2nd lightwave signal] ... The Hikari transmitter-receiver, 2 ... The source of laser luminescence (luminescence means), 3 ... The joint lens of optical equipment, 4

[Translation done.]

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図.

【図１０】本発明の光送受信装置の別の実施の形態を示す図.

【図１１】本発明の光送受信装置の別の実施の形態を示す図.

【図１２】本発明の光送受信装置の別の実施の形態を示す図.

【図１３】本発明の光送受信装置の別の実施の形態を示す図.

【図１４】本発明の光送受信装置の別の実施の形態を示す図.

【図１５】本発明の光送受信装置の別の実施の形態を示す図.

14

＊【図１６】本発明の光送受信装置の別の実施の形態を示す図.

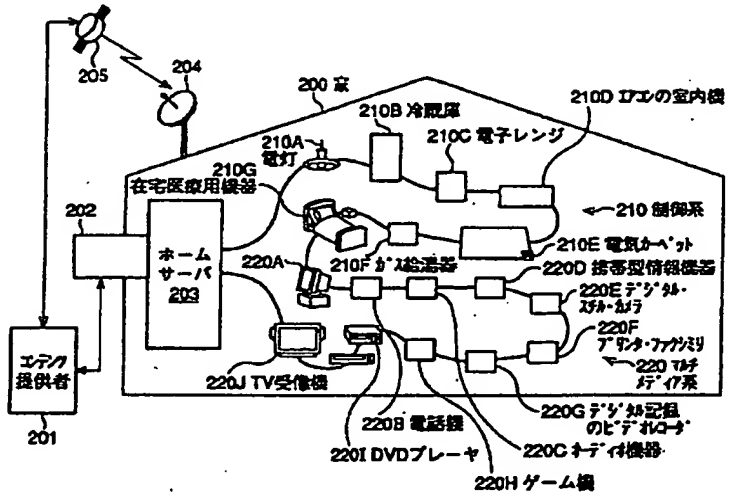
【図１７】本発明の光送受信装置の別の実施の形態を示す図.

【図１８】従来の光送受信装置を示す図.

【符号の説明】

１・・・光送受信装置、２・・・レーザ発光源（発光手段）、３・・・光学装置の結合レンズ、４・・・光学装置の立ち上げミラー、５・・・フォトダイオード（受光手段）、７・・・パッケージ、８・・・光線（入射光）、１１・・・光ファイバ、１１ａ・・・端部、１１ｂ・・・光ファイバの端面、２０・・・光学装置、Ｓ１・・・第１光信号、Ｓ２・・・第２光信号

【図１】

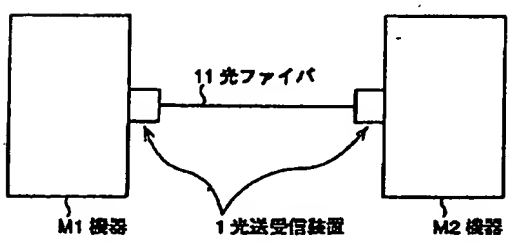


【図６】

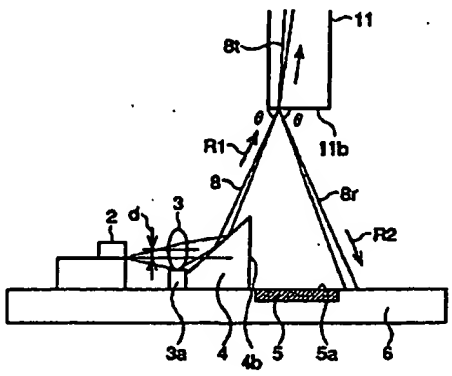
光ファイバ外径	1,000 μm
被覆外径	2.2mm
被覆材質	ポリエチレン
伝送損失	14dB／100m＊
帯域	160MHz@100m＊

(＊650nm単色平行光による参考値)

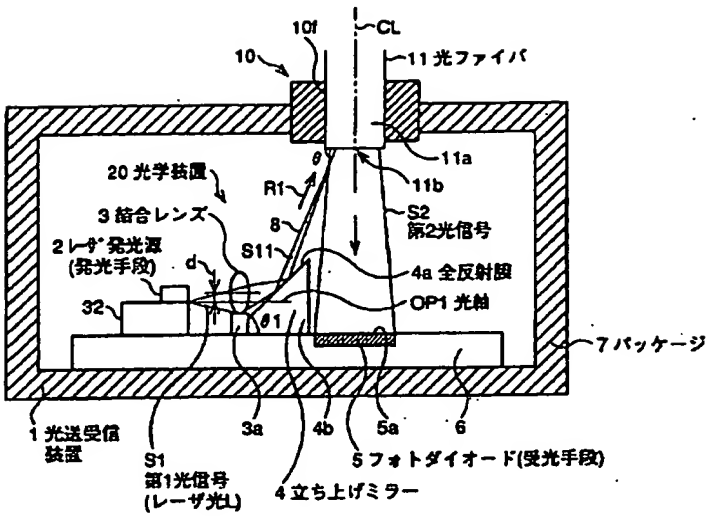
【図２】



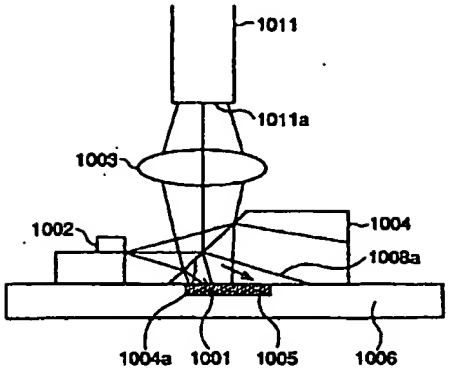
【図４】



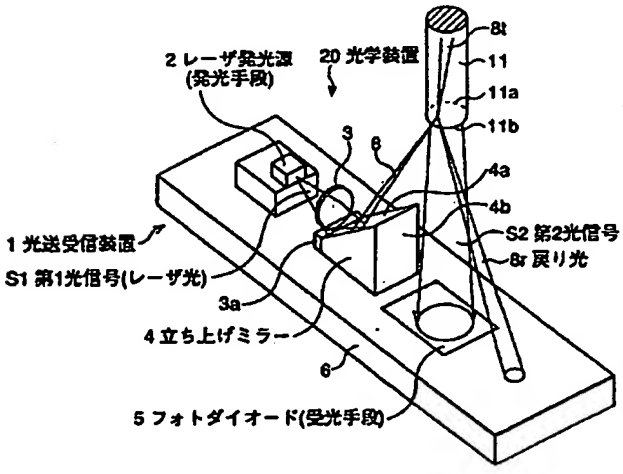
【図3】


10f
CL
10
11 光ファイバ
11a
11b
20 光学装置
R1
θ
3 結合レンズ
8
S2
第2光信号
2 レーザ発光源
(発光手段)
S11
d
4a 全反射膜
32
OP1 光軸
θ1
7 パッケージ
1 光送受信
装置
3a
4b
5a
6
S1
第1光信号
(レーザ光L)
4 立ち上げミラー
5 フォトダイオード(受光手段)

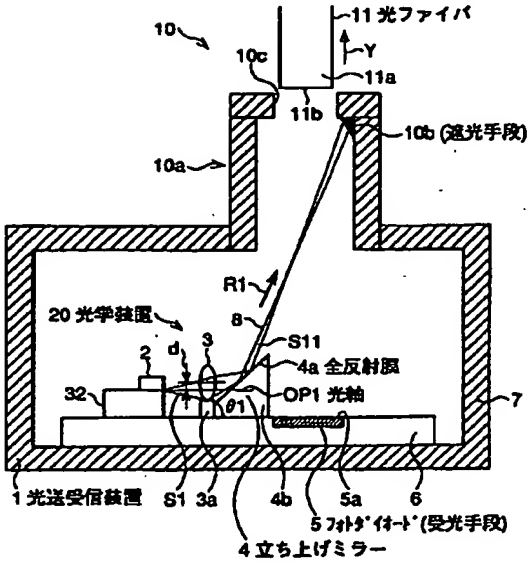
【図18】


1011
1011a
1003
1002
1004
1008a
1004a
1001
1005
1006

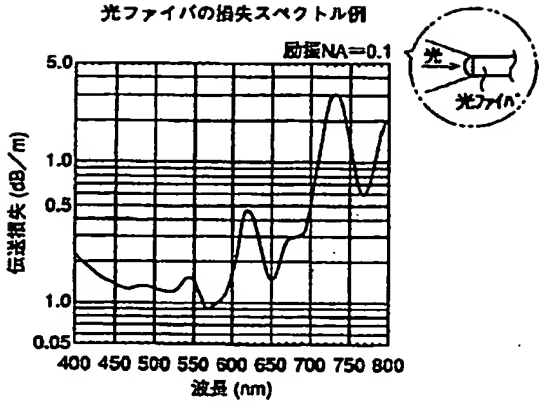
【図5】


8t
2 レーザ発光源
(発光手段)
20 光学装置
11
11a
11b
3
6
4a
4b
1 光送受信装置
S2 第2光信号
8r 戻り光
S1 第1光信号(レーザ光)
3a
4 立ち上げミラー
6
5 フォトダイオード(受光手段)

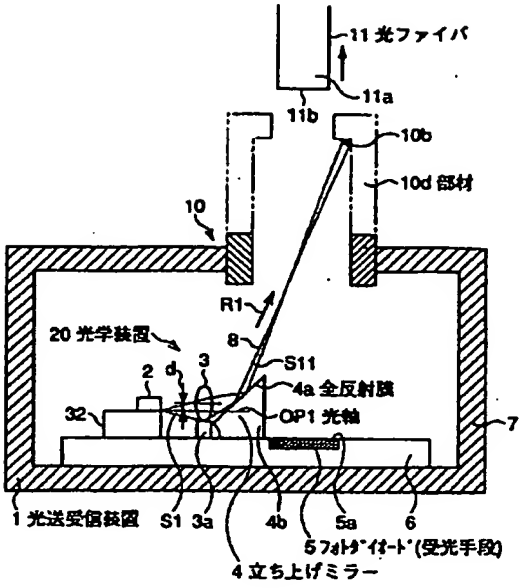
【図8】


10
11 光ファイバ
Y
10c
11a
11b
10b (遮光手段)
10a
R1
20 光学装置
8
S11
2
d
3
4a 全反射膜
32
OP1 光軸
θ1
7
1 光送受信装置
S1
3a
4b
5a
6
5 フォトダイオード(受光手段)
4 立ち上げミラー

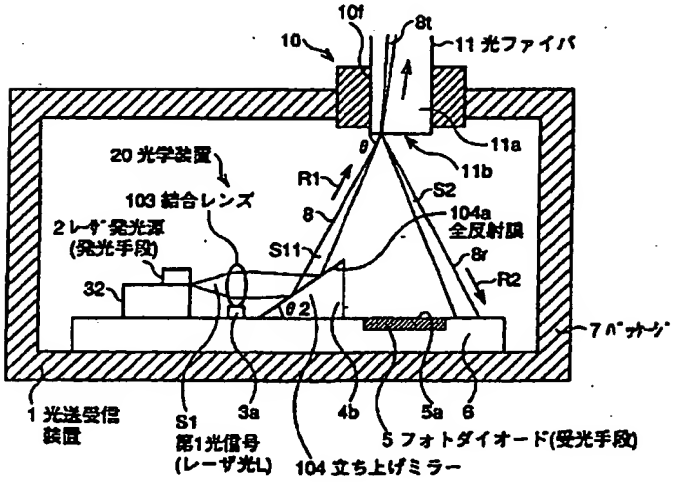
【図７】


光ファイバの損失スペクトル例
励振NA=0.1
光
光ファイバ
伝送損失 (dB/m)
5.0
1.0
0.5
1.0
0.05
400 450 500 550 600 650 700 750 800
波長 (nm)

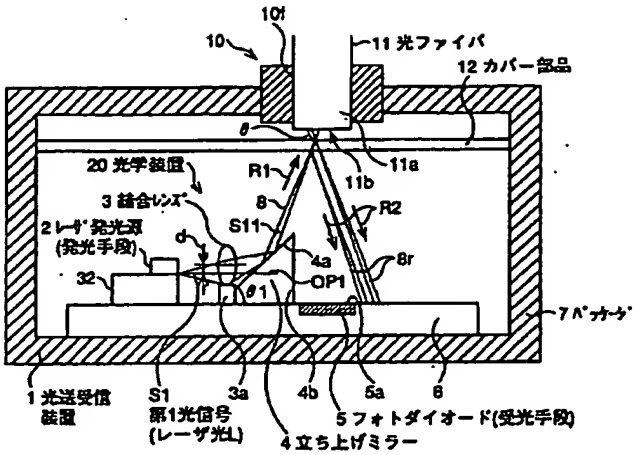
【図９】


11 光ファイバ
11a
11b
10b
10d 部材
10
R1
20 光学装置
8
S11
2
d
3
4a 全反射膜
32
OP1 光軸
7
1 光送受信装置
S1
3a
4b
5a
6
5 フォトダイオード(受光手段)
4 立ち上げミラー

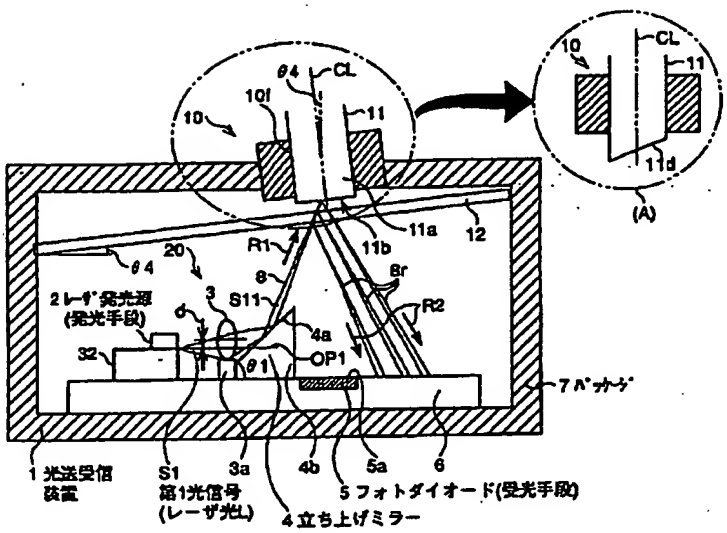
【図１０】


10f
8t
10
11 光ファイバ
11a
θ
11b
20 光学装置
R1
S2
103 結合レンズ
8
104a
全反射膜
2 レーザ発光源
(発光手段)
S11
8r
R2
32
θ2
7 パッケージ
1 光送受信
装置
S1
第1光信号
(レーザ光L)
3a
4b
5a
6
5 フォトダイオード(受光手段)
104 立ち上げミラー

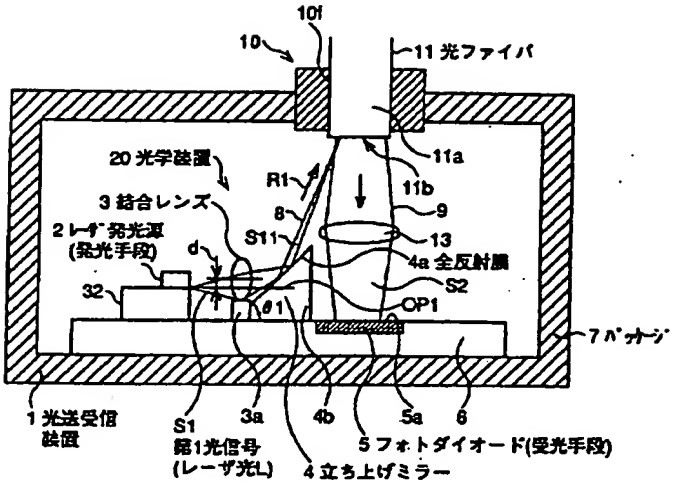
【図11】


10f
10
11 光ファイバ
12 カバー部品
θ
20 光学装置
R1
11b
11a
3 結合レンズ
8
R2
2 レーザ発光源
(発光手段)
S11
d
4a
8r
32
θ1
OP1
7 パッケージ
1 光送受信
装置
S1
第1光信号
(レーザ光L)
3a
4b
5a
6
5 フォトダイオード(受光手段)
4 立ち上げミラー

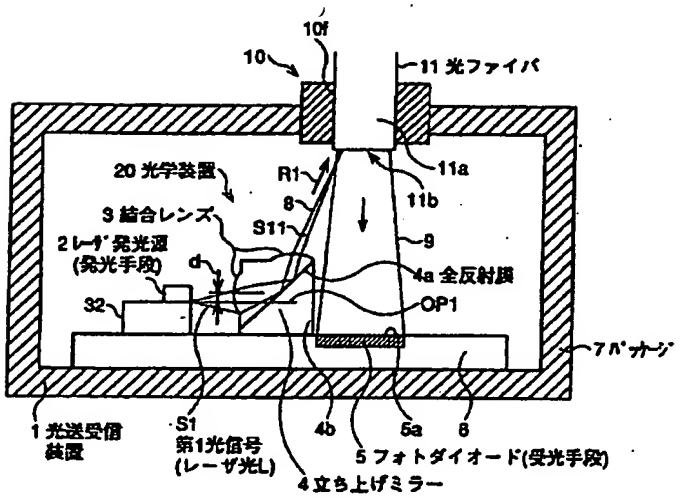
【図12】


θ4
CL
10f
10
11
11a
12
R1
20
11b
θ4
8
8r
3
S11
2 レーザ発光源
(発光手段)
d
4a
R2
32
θ1
OP1
7 パッケージ
1 光送受信
装置
S1
第1光信号
(レーザ光L)
3a
4b
5a
6
5 フォトダイオード(受光手段)
4 立ち上げミラー
10
CL
11
11d
(A)

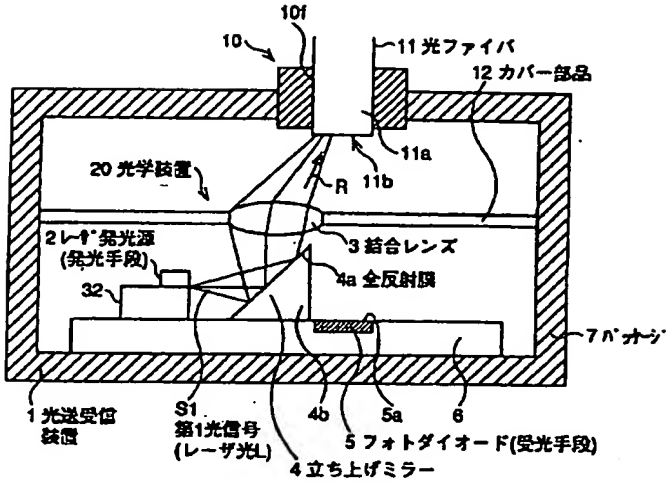
【図１３】


10f
10
11 光ファイバ
20 光学装置
R1
11a
11b
3 結合レンズ
8
9
2 ﾚｰｻﾞ発光源
(発光手段)
S11
13
d
4a 全反射膜
32
S2
θ1
OP1
7 ﾊﾟｯｹｰｼﾞ
1 光送受信
装置
S1
第1光信号
(レーザ光L)
3a
4b
5a
6
5 フォトダイオード(受光手段)
4 立ち上げミラー

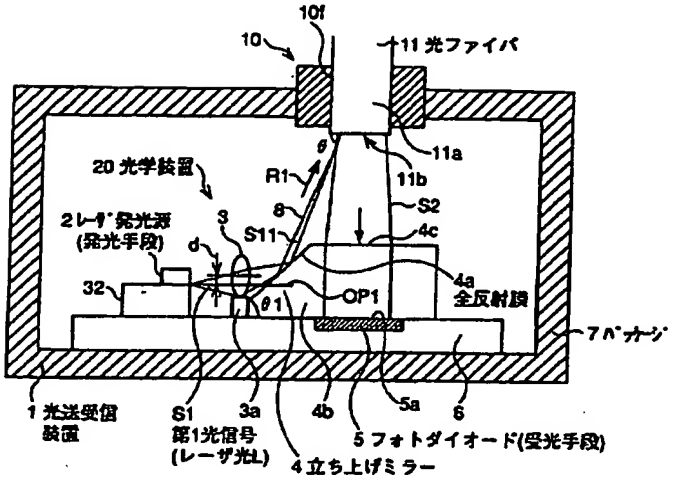
【図１４】


10f
10
11 光ファイバ
20 光学装置
R1
11a
11b
8
3 結合レンズ
S11
9
2 ﾚｰｻﾞ発光源
(発光手段)
d
4a 全反射膜
32
OP1
7 ﾊﾟｯｹｰｼﾞ
1 光送受信
装置
S1
第1光信号
(レーザ光L)
4b
5a
6
5 フォトダイオード(受光手段)
4 立ち上げミラー

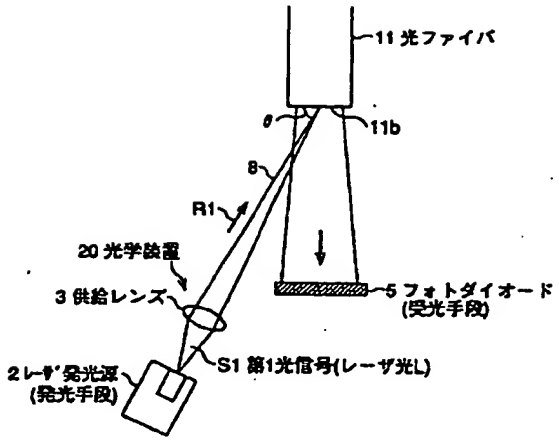
【図15】


10f
10
11 光ファイバ
12 カバー部品
11a
11b
R
20 光学装置
2 レーザ発光源
(発光手段)
3 結合レンズ
4a 全反射膜
32
7 パッケージ
1 光送受信
装置
S1
第1光信号
(レーザ光L)
4b
5a
6
5 フォトダイオード(受光手段)
4 立ち上げミラー

【図16】


10f
10
11 光ファイバ
11a
11b
θ
R1
20 光学装置
2 レーザ発光源
(発光手段)
3
S11
S2
4c
d
8
32
θ1
OP1
4a
全反射膜
7 パッケージ
1 光送受信
装置
S1
第1光信号
(レーザ光L)
3a
4b
5a
6
5 フォトダイオード(受光手段)
4 立ち上げミラー

【図１７】



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